3.0 PURPOSE AND NEED

3.1 Project Purpose

The linkage between the need for dredging in Gloucester Harbor and the regulatory challenges involved with the disposal of UDM, associated with dredging projects identified in the Gloucester Harbor Plan, forms the basis for the Gloucester Harbor DMMP. While this section describes dredging needs for Gloucester Harbor, the focus of this DEIR is on disposal options for UDM. This section also characterizes the quality and quantity of dredged sediments for dredging projects, establishing the magnitude of UDM requiring disposal and the types of measures and site characteristics required for safe disposal of UDM.

As discussed in Section 2, the lack of a practicable cost-effective method for the disposal of UDM in an environmentally sound and cost effective manner has been a long standing obstacle to the successful completion of dredging projects in Gloucester Harbor. The basic project purpose of the Gloucester Harbor DMMP, is to identify, evaluate and permit, within the Gloucester Harbor upland or aquatic Zones of Siting Feasibility (ZSFs) a site (or sites) or alternative treatment technology, for the disposal of UDM over the next twenty year planning horizon for both public and private dredging projects.

The inability to find a practicable, environmentally sound, cost-effective method for disposal or management of UDM will restrict the maintenance and improvement of Gloucester's waterways (Figures 3-1 and 3-2) and ultimately, implementation of the Gloucester Harbor Plan.

3.2 Harbor Planning Context

The February 1996, passage of the Seaport Bond Bill, included a provision for funding assistance to the state's major commercial ports to conduct comprehensive harbor development and management plans. This "Four Ports Initiative," undertaken by Gloucester, Salem, New Bedford and Fall River with technical assistance from MCZM, on behalf of the Secretary of the EOEA, is being closely coordinated with the DMMP. As part of the local harbor planning process, Gloucester has developed a Harbor Plan to guide the development of the harbor over the planning horizon, providing a framework for future decisions related to port development.

A harbor plan, approved by the Secretary of the EOEA, is a document having significant impact upon the viability of planning initiatives in the port. The plan allows Gloucester to have greater flexibility in implementing a development strategy tailored to its port's needs and the City's visions of economic development and environmental quality. The plan also identifies funding needs which are critical to its implementation. The development option put forward in the plan represents the City's harbor planning goals and vision for the next five years.

The preparation of the Gloucester Harbor DMMP, also funded through the Seaport Bond Bill, has been coordinated with local planning efforts. Coordination with local harbor planning interests has been a critical component of the development of this DEIR. The simultaneous preparation of the harbor plan and the DMMP has helped with the identification of Gloucester Harbor's future dredging needs as well as potential sites for the disposal of UDM.

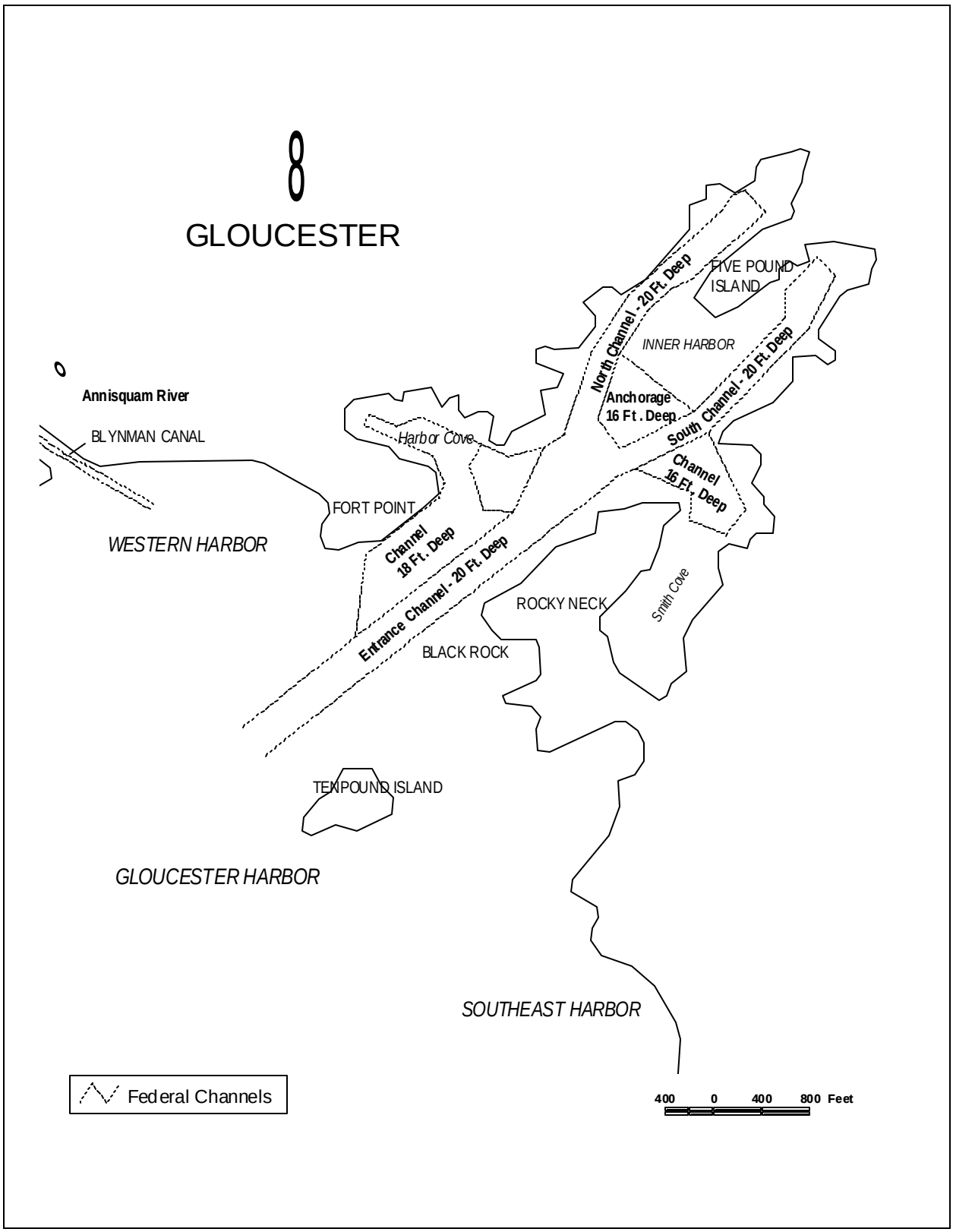

Figure 3-1: Federal navigation channels in Gloucester Harbor.

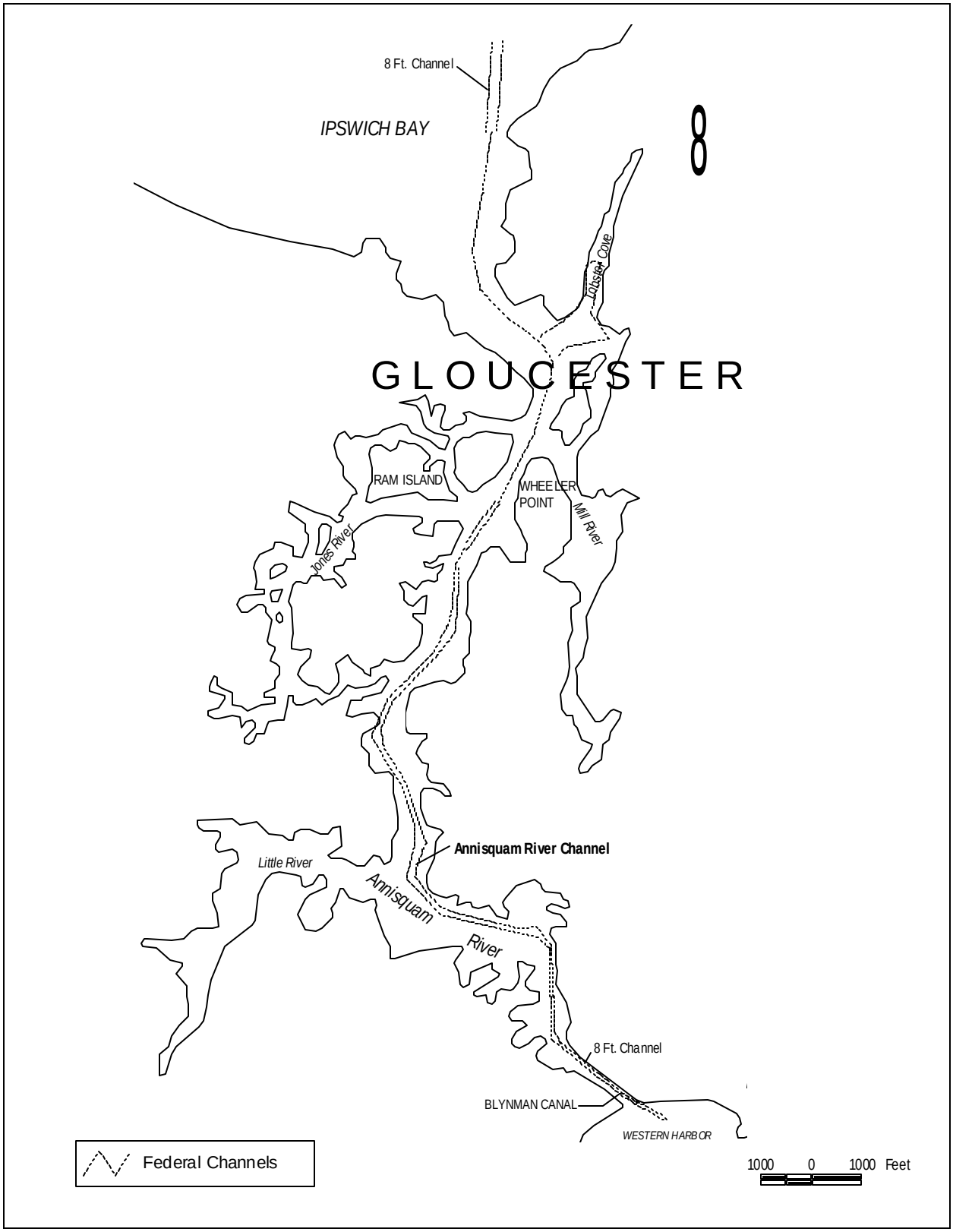

Figure 3-2: Annisquam River federal channel limits.

Gloucester has prepared a Harbor Plan, that has been submitted to and approved by MCZM. The development of the Gloucester Harbor Plan has been guided by the following mission statement to achieve:

> *"a publicly accessible Gloucester Harbor that expands its position as a vital economic asset to the City and the Commonwealth, while retaining its natural beauty and historic character. Above all the Plan seeks to continue the Harbor as a working, productive port".*

The goals of the Plan, which were developed with public input, articulate the Plan's broad scale intentions. The goals defined in the Gloucester Harbor Plan include the following:

- Promoting economic diversity and sustainable employment
- Strengthening commercial fishing/marine industry
- Developing historical, cultural and natural assets
- Benefitting the downtown and other areas of the city
- Providing infrastructure and navigation improvements
- Developing a viable implementation and management strategy

The Plan identifies the challenges the Harbor faces in achieving the above mission statement and goals. The plan presents the following "three-pronged approach" to planned, coordinated future development:

- **Rebuild the Harbor Infrastructure** - on land and water as a baseline to benefit all users and activities. The Plan defines fundamental public improvements to be undertaken by the City that are needed to sustain the function of the Harbor and to support needed development.
- **Strengthen the traditional port** - including facilities and businesses on historic finger piers, by providing assistance to private owners through a non-profit partnership. While the details of the partnership remain to be worked out, it is intended to advocate for investments and improvements in traditional small-medium scale sites and activities of the Harbor that are important to economic diversity, entrepreneurship, and the image of the City as a working port.
- **Develop historical and cultural assets** - by establishing the Gloucester Marine Museum on the downtown waterfront as a gateway to Gloucester and centerpiece for an organized network of visitor sites and businesses. These activities can help to support existing downtown businesses as well as attract beneficial new private investment into the area.

The Gloucester Harbor Plan, establishes a framework to using the "three-pronged" approach to implement the Plan's recommendations. Dredged material disposal alternatives for Gloucester Harbor identified in this DEIR have been screened for their consistency with the Gloucester Harbor Plan mission statements and planning goals listed above, to ensure that the preferred disposal alternatives assist in the achievement of the goals of the Harbor Plan.

Throughout the MEPA process and the development of this DEIR, MCZM provided the technical information necessary to identify the preferred alternative disposal sites and will make recommendations based upon that information; however, it is the responsibility of the City of Gloucester to determine the appropriateness of any site selected. The identification of the preferred alternative disposal site(s) has been coordinated with the City of Gloucester throughout the harbor planning process.

3.3 Project Need

This section describes the need to find an appropriate suitable dredged material disposal site. This section is divided into three primary areas: dredging history; dredging inventory; and, sediment quality and quantity. The dredging history portion of this section describes historical harbor dredging. The dredging inventory documents the current dredging needs of private and public entities in Gloucester Harbor and the Annisquam River. Finally, sediment chemistry data from recent and historical sampling and testing efforts are summarized, and the suitability of dredged material for ocean disposal is assessed.

3.3.1 Dredging History

Based on dredging records collected in the Massachusetts Navigation and Dredging Management Study that was completed by the USACE for the State of Massachusetts (USACE 1995), a total of 1,178,370 cubic yards (cy) of material has been dredged from Gloucester Harbor and the Annisquam River since 1932. Much of this volume was dredged prior to 1966, when the federal channel and anchorage areas were created. Additional dredging in the harbor since construction of the channel dredging has included USACE maintenance dredging, projects performed by MDEM at various locations, city dredging and many private dredging operations.

3.3.2 Dredging Inventory

The volume of sediment to be dredged from Gloucester Harbor over the next twenty years has been estimated through surveys conducted by the USACE (1996) and Maguire (1997). The dredged material volume estimates are needed to identify, plan and permit a disposal site(s) with sufficient long-term capacity to accomodate the needs for Gloucester Harbor.

The total volume of sediment to be dredged from Gloucester Harbor over the next 20 years is estimated at 514,440 cy. This figure includes a 20% contingency added to the surveyed volume to account for any uncertainty in the volumes provided by the marine users. The volumes presented in the sub-sections below are *without* the 20% contingency.

During the 1997 survey, all shoreline marina owners, municipalities, utilities, state and federal agencies were contacted via a mail-back questionnaire, with follow-up telephone calls to non-respondents. Marine users were asked to complete a questionnaire, denoting dredging footprints, volumes, and anticipated time schedule over the next 20 years.

There were over fifty facilities. The maintenance dredging of the Annisquam River is the largest project. The USACE has stated that the River is in need of maintenance dredging immediately. The Annisquam River is subject to heavy siltation and, on average, requires dredging every 8 years. Therefore, over the 20-year planning horizon, an additional maintenance dredging of the river has been included in the inventory. Of the 106,000 cy of dredging in the Annisquam, the USACE is currently planning to dredging only the 47,000 cy of sediment in the main channel that has been deemed suitable for ocean disposal or beach nourishment. The remaining 59,000 cy of sediment from Lobster Cove and the Blynman Canal, which are likely unsuitable for ocean disposal, would be dredged at a later time in the 20-year planning horizon.

Dredging of privatefacilities comprises a significant portion of the total material to be dredged from Gloucester (Figure 3-3). There are no maintenance or improvement dredging projects planned for the Gloucester Harbor federal channel and anchorage areas. In the original dredging inventory (1997), a proposed deepening of the federal channel from 20 feet to 26 feet was identified as a potential project involving 427,000 cy of dredging in the entrance channel, north channel and anchorage area (Figure 3-1) . A USACE study showed that this deepening project would not be cost effective. The 70,000 cy of maintenance dredging was researched and was also found not to be cost effective at this time.

Because no major rivers empty into Gloucester Harbor, and off-shore drift does not transport significant amounts of sediment into the basin, sediment accumulation (i.e. shoaling) within the federal channel and anchorage areas occurs at a very slow rate. The USACE has calculated an accumulation rate of only 22,000 cy over a 10-year period. Accumulation rates in marina areas, however, are higher because of several factors including resuspension of sediments from boat propellers and slower water currents.

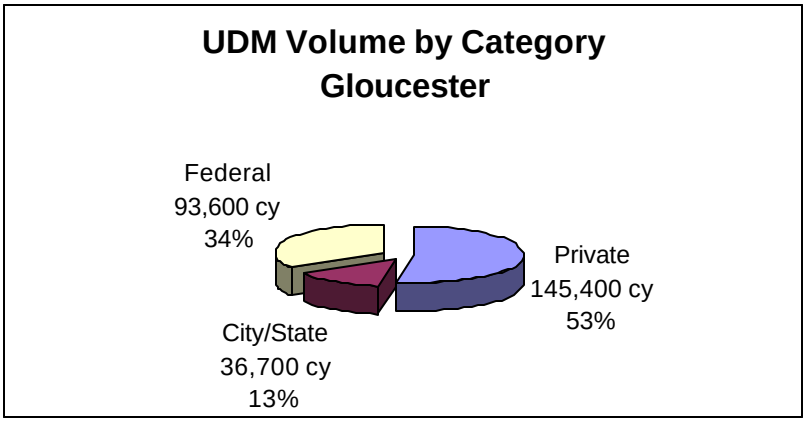

Figure 3-3: UDM Volume for Gloucester by Project Type
(does not include 20% contingency)

3.3.3 Sediment Quality and Quantity

3.3.3.1 Sediment Quality - Conformance with Regulatory Requirements

USEPA Protocol

The evaluation of sediments proposed for dredging is conducted by federal and state regulatory agencies. The USEPA, USACE, NMFS, and USFWS, through an inter-agency agreement, are responsible for development and review of all sampling and testing for dredging and dredged material disposal in Massachusetts. At the state level, DEP and MCZM review sampling and testing under the purview of the Coastal Zone Management Act (CZMA) and Section 401 of the Clean Water Act (CWA). The federal agencies jurisdiction comes from Section 404 of the CWA. Sampling and sediment testing for the Gloucester Harbor DMMP DEIR followed published protocol of the USEPA and USACE. The protocol (Evaluation of Dredged Material Disposal for Ocean Disposal, USEPA/USACE, Feb. 1991) involves a tiered approach. Tier I involves a literature search on potential contaminant sources, history of dredging, natural harbor features and other factors.

The first step of Tier II involves the physical analysis of samples (grain size, organic carbon content). These results are reported to the USACE, which, in turn determines which samples are to be composited for bulk chemical analysis. The only sediments that would not require further testing are those that consist of greater than 90% sand and/or are in areas of high currents and no major pollution sources as determined by USACE. In Gloucester, there are no sediments that meet this "exclusionary" criteria. The harbor has numerous point and nonpoint pollution sources and is almost entirely a depositional area because of relatively slow currents and tidal action.

After the bulk chemical analysis is complete, results are presented to the federal agencies for their review and evaluation. According to USEPA, if a substance is detected in sediments above "trace amounts", biological-effects testing (Tier III) is required. USEPA interprets "trace amount" as being any concentration that is above laboratory detection levels. If all substances are below trace levels, then no additional testing is required and sediments are deemed suitable for ocean disposal.

An inventory of potential pollution sources and historic sediment quality data in and near Gloucester Harbor was conducted as part of the DMMP Phase 1 (Maguire 1997). This information was used by the regulatory agencies to develop site-specific sampling and testing plans for the Gloucester Federal Channel Deepening Project and the Annisquam River maintenance dredging. As mentioned in Section 3.3.2 above, the deepening of the federal channel is no longer desired, therefore the associated sediment data is not specific to any planned project in Gloucester Harbor. However, the data is representative of the Harbor as a whole, and as such, can be used to indicate the type of relative levels of contaminants present in any one of the facilities in the Harbor area.

A management strategy will be developed by the appropriate state and federal regulatory agencies as to the sampling and testing requirements for specific dredging projects in the harbor.

Sampling and testing plans for the federal channel and the Annisquam River were developed in a coordinated effort by USEPA, USACE, NMFS and USFWS with input from DEP. The plans for

Gloucester Harbor were completed in early 1998. Sampling and testing was conducted in the spring/summer of 1998. A summary of the results is presented below and detailed information is contained in Appendix E.

Physical Testing

Surficial sediments in the entrance channel and north channel are fine-grained, generally grey to black in color and anoxic, with some sulfur odor. Organic carbon content is moderate to high.

Deeper sediments in the channel areas (3-6 ft. below the surficial sediments) are also fine-grained but they are composed of lean clays that are grey and homogenous. Thin sand layers are found in some of the deeper sediment layers.

Conversely, Annisquam River sediments are composed primarily of sands. In fact, of the ten samples taken from the river, only one, LC-B, had greater than 10% fines. The LC-B sample was taken in Lobster Cove, a backwater area where patches of sand and silt accumulate.

Bulk Chemistry

Sediments were analyzed for a list of contaminants determined by USACE/USEPA policy including: metals, polycyclic aromatic hydrocarbon (PAH), pesticides and polychlorinated biphenyl (PCB) content. All these classes of chemical have been detected in previous samples in the harbor and have the potential to occur in the sediments due to the presence of several point and non-point pollution sources in the area.

Although a direct comparison of chemistry test results to ocean disposal site reference values is not used to determine sediment suitability for ocean disposal, chemistry results are compared to the MBDS reference site values so that the nature of the sediments in Gloucester Harbor can be viewed in a useful context. The MBDS reference values reflect sediment samples taken near the MBDS. As previously described, dredged material deemed suitable for unconfined open ocean disposal may be taken to MBDS (Figure 3-4).

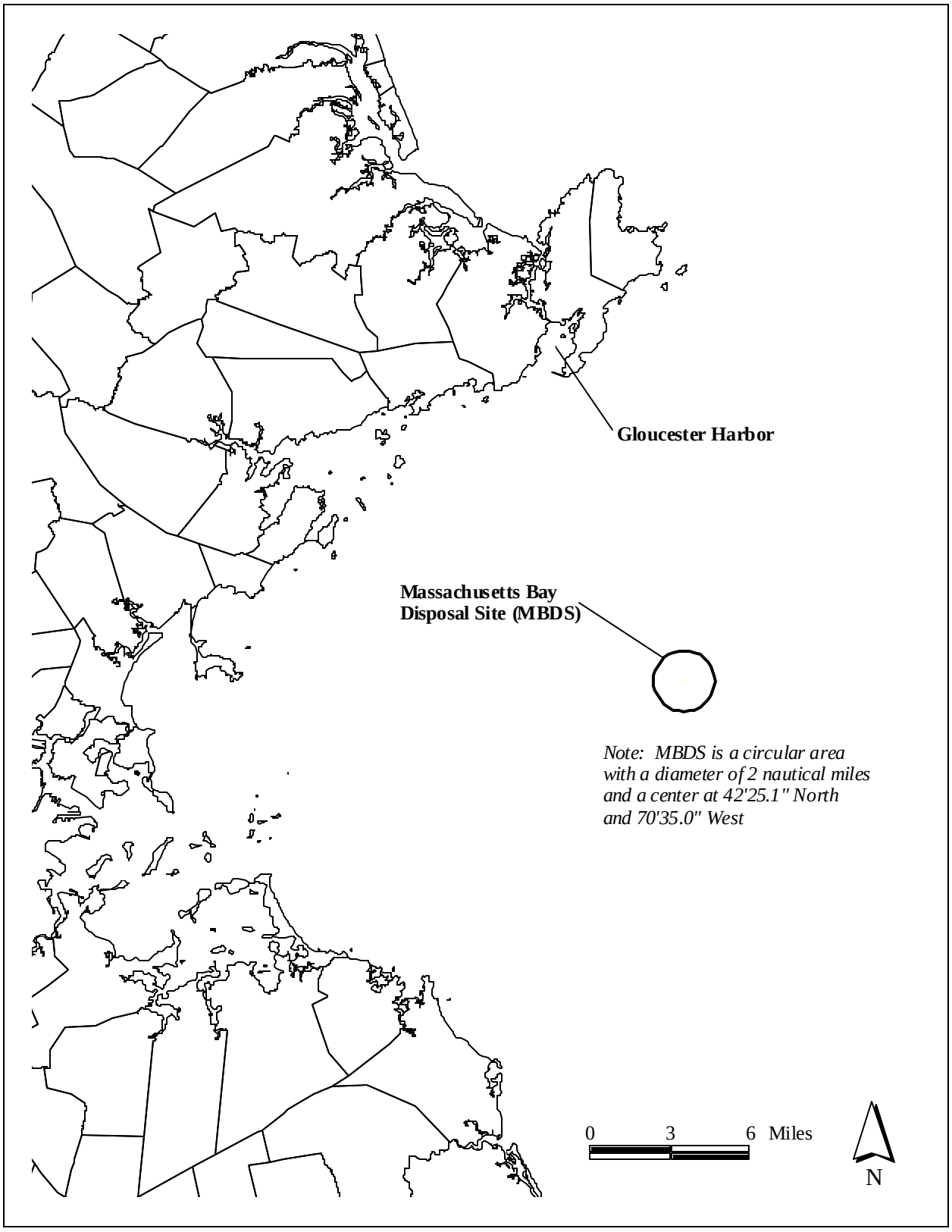

Figure 3-4: Location of Massachusetts Bay Disposal Site (MBDS)

Table 3-1 summarizes the mean (average) concentrations of selected substances found in measurable quantities in the sediments from the major dredging projects.

Table 3-1: Summary of concentration of selected contaminants in Gloucester sediments.

Analytes	Annisquam River		Federal Channel		MBDS Reference
	Mean	*Range*	*Mean*	*Range*	
Arsenic	0.965 ppm	0.25 - 3.2	12 ppm	1.9 - 24	28.7 ppm
Cadmium	0.17 ppm	0.05 - 1.1	0.98 ppm	0.15 - 2.4	2.74 ppm
Chromium	0.13 ppm	4 - 70	35 ppm	11 - 41	152 ppm
Copper	9.71 ppm	0.5 - 35	62 ppm	10 - 140	31.7 ppm
Mercury	0.053 ppm	0.025 - 0.23	0.24 ppm	0.025 - 0.43	0.277 ppm
Nickel	4 ppm	1 - 10	16.7 ppm	8 - 27	40.5 ppm
Lead	19.3 ppm	1 - 71	86 ppm	7 - 190	66.3 ppm
Zinc	55.6 ppm	7 - 350	127.8 ppm	48 - 310	146 ppm
Total PAH	2,670 ppb	15-6,803	12,372 ppb	14 - 32,670	2,996 ppb
Total PCBs	38 ppb	6 - 136	113 ppb	0 - 259	ng

Notes:
Underline denotes greater than MBDS Reference
MBDS Reference is mean plus 2 standard deviations
ng = no guideline

The chemical found in sediments are indicators of the present and past marine activities in Gloucester Harbor which include boat paints, fuel and oils, bulk chemicals, and other marine cargo.

Of the eight metals studied, copper and lead are the most prevalent in Gloucester Harbor. Mean concentrations in surface sediments of the entrance channel and north channel are slightly elevated above the MBDS reference value. Sediments in the Annisquam River contain low levels of metals, all below the MBDS reference values. Copper and lead are common pollutants in estuaries, because they are common substances in the upland environment. Lead was once used in gasoline as an "anti-knocking" agent before it was banned from use in the 1980s. Lead is also a common soldering material in older plumbing. Copper is the most common material used for piping since the 1950s. In addition to their use in plumbing components, copper and lead are also commonly used in manufacturing processes. Most metals have a tendency, once entering the water, to adsorb to suspended sediment particles which then settle to the harbor bottom.

Total PAH concentrations in Gloucester Harbor are, on average, four times higher than the MBDS reference guideline (Figure 3-5). Concentrations in the Annisquam River sediments are generally near or

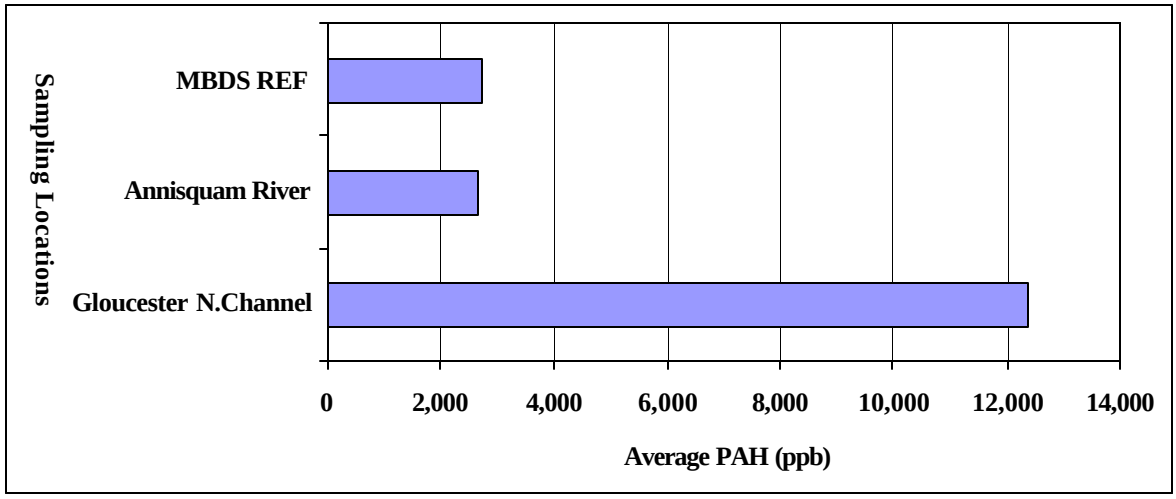

Figure 3-5: Average PAH concentrations (ppb) in sediment samples collected from Gloucester Harbor, Annisquam River and MBDS Reference Site.

below the MBDS reference guideline, with the exception of Lobster Cove, where total PAH levels were measured at about 5,000 ppb.

Polycyclic aromatic hydrocarbons (PAH) are a class of chemicals that are formed by the incomplete combustion of fuel. Sources of PAH include power generation, stormwater runoff, industrial discharge and dry deposition from the atmosphere.

There are no MBDS reference values for pesticides, but there are some numerical guidelines that have been developed by National Oceanic and Atmospheric Administration (NOAA) and the New England River Basins Commission (NERBC). Pesticide concentrations harbor-wide are generally low compared to these guidelines, however, elevated DDT and DDT-derivative compounds were found in the federal channel. This is consistent with the spatial distribution of other contaminants such as metals and PAHs within the harbor. Pesticides, as the name implies, are used to control weeds, fungi, rodents and other undesirable organisms. While many chlorinated pesticides have been banned from use in the United States, their historic production and chemical stability have allowed them to persist in the environment.

Polychlorinated biphenyls (PCBs) were detected in most federal channel and Annisquam River sediment samples. The highest PCB readings in the federal channel samples were in the North Channel and the highest measurements in the Annisquam River were in Lobster Cove. There are no sediment quality guidelines for PCBs (congener-specific) so the toxicological and ecological significance of the concentrations in Gloucester Harbor sediments cannot be assessed without further biological testing.

PCBs were once used as cooling fluids in transformers and other electrical equipment. Since 1976, PCBs have been banned from manufacturing and use in the United States due to their potential acute and chronic effect on the environment. PCBs were widely used and their chemical stability has allowed them to remain in the environment.

Biological Testing

In accordance with the EPA protocol discussed in the above section, Tier III biological-effects testing would be required if disposal at the MBDS is proposed. Any private or public dredging project that proposes ocean disposal at the MBDS must undergo biological testing to determine if sediments are suitable. The biological testing requirements (if any) for disposal at any of the preferred aquatic disposal sites within the Harbor, will be determined at a later date by the approprate regulatory (state and federal) agencies.

1) Suspended particulate phase bioassays; this test is used to determine the short-term effect of dredging and disposal on sensitive water column organisms. If significant short-term effects are anticipated, then dredging and disposal management restrictions can be employed to minimize impacts. This testing is required for disposal at MBDS, but it can also be used to estimate impacts at the point of dredging. It has not yet been determined whether these tests will be required for dredging or disposal within the Harbor.

2) Solid phase toxicity test; over a 10-day period, sensitive marine amphipods are exposed to test sediments to determine the acute toxicity (lethality) of the sediment.

3) Solid phase bioaccumulation test; sediment dwelling organisms are exposed to test sediments over a 28-day period to determine acute and chronic effects of the sediment. The tissues of surviving organisms are then analyzed for the chemicals of concern.

No biological tests were undertaken as part of the Gloucester Harbor DMMP. Testing requirements for dredging projects proposing to use a CAD cell will be determined as one component of the management plan to be developed.

3.3.3.2 Sediment Quantity - Suitable versus Unsuitable Volumes

The determination of the suitability for sediments for ocean disposal is made by the federal agencies on a case-by-case basis. As stated earlier, the dredging projects identified in the dredging inventory must undergo the full suite of tests necessary to determine if the sediments are suitable for ocean disposal. Nevertheless, the sediment sampling and testing of the Gloucester Harbor entrance and north channels and the Annsiquam River during DMMP Phase 1 (Maguire 1997) gives insight into the characteristics of sediments to be dredged in the harbor channels, anchorages, marinas and boat basins. This information has been used to estimate the suitability of sediments at proposed dredging locations in the harbor.

Sediment chemistry data presented in this section for the federal channel in Gloucester Harbor and the Annisquam River were used to evaluate other nearby projects in those areas. Those facilities that are distant from any sampling locations were assessed based on: historic sediment quality data (if any); proximity to pollution sources; and, general oceanographic conditions, i.e. is the site within a high or low energy environment.

Given the sediment chemistry data presented above, it is likely that sediments in Gloucester Harbor marinas, boat launches and other facilities would be unsuitable for ocean disposal at MBDS because of their elevated PAH and metals content, primarily.

Most reaches of the Annisquam River contain contaminant levels well below the MBDS reference values. These sediments are primarily sand and are likely suitable for ocean disposal or beach nourishment. However, there are two areas of the river, Lobster Cove and Blynman Canal, that contain a higher silt fraction and correspondingly higher metals and organic contaminant concentrations. These areas are assumed to be unsuitable for ocean disposal. Once the UDM sediments from these two areas have been removed during the initial maintenance dredging, the sediments that accumulate in these areas should be low in contaminant levels because no major ongoing sources of contamination were noted in the Due Diligence study (Maguire 1997a).

Several marinas in the Annisquam River are located near channel sediment sample locations that are suitable for ocean disposal. While these facilities may contain suitable dredged material, it is assumed, to be conservative in planning for the sizing of potential disposal sites, that these sediments are also unsuitable for ocean disposal.

Given the assumptions presented above, it is estimated that approximately 276,000 cy of sediment to be dredged from Gloucester Harbor over the next 20 years would be UDM. For planning purposes, a 20% contingency has been added to the unsuitable volume to arrive at a volume of approximately 333,000 cy.

Table 3-2: Dredged material volumes (cy) for Gloucester Harbor for next 20 years

Inventory Total	Inventory Total with Contingency[1]	Suitable Dredged Material[2] with Contingency	Unsuitable Dredged Material[3] with Contingency
428,700	514,440	183,600	**330,840**

Notes:
[1] Contingency is 20%
[2] Suitable for disposal at MBDS
[3] Not suitable for disposal at MBDS

Depending on the selection of disposal type (upland, aquatic) and location, there may be an additional volume of UDM. For example if a CAD cell footprint contains UDM, then the volume of material excavated for the creation of the CAD cells would also have to be managed as UDM. This scenario is discussed in greater detail in Section 8.0.

As part of the dredging inventory, marine users were asked to estimate the time frame for their anticipated dredging projects. Table 3-3 portrays the timing estimates for disposal of UDM from Gloucester Harbor. As shown, the majority of the UDM would be dredged in the first 10 years. The timing of the dredging projects may change over time depending on many factors including the availability of dredged material disposal sites. Nevertheless, the dredging breakdown by 5-year increments demonstrates the immediate need for dredging.

Table 3-3: Twenty year dredged material volume[1] (cy) breakdown in 5-year increments

Years 1-5	Years 6-10	Years 11-15	Years 16-20	Total
159,695	126,190	22,575	22,380	330,840

Notes:
[1] Includes 20% contingency

3.4 Harbor Plan Implementation

The implementation recommendations in the Gloucester Harbor Plan have been grouped as follows: navigation improvements, public use and access, streets and parking, program to strengthen the working port and developing cultural and visitor use potentials, outlines the projects, initiatives development opportunities, and studies to be accomplished in a five to seven year period. This implementation schedule establishes the blueprint for "making the vision happen". The proposed Harbor Infrastructure improvements to navigation including public dredging and private piggy back dredging projects have been identified as the foundation of the action items identified necessary to realize the vison established in the Gloucester Harbor Plan.

The formal identification of the need for dredging by the City, as defined in the Gloucester Harbor Plan, and the characterization of a portion of that proposed dredged material in the DMMP planning process as UDM, underscores the importance of locating a long-term cost-effective, environmentally sound disposal option. The technical assistance provided by MCZM to the City in developing a disposal solution for UDM will help the City and the Commonwealth meet the mission statement and goals of the Gloucester Harbor Plan and achieve the Basic Project Purpose of the DMMP. Identification of a practicable UDM disposal option will help attain the City's vision of maintaining a vibrant seaport, while preserving Gloucester's maritime heritage, and furthering economic development.